I. Early Earth and the Origin of Life

**Module 16.1 Life began on a young Earth.**

1. The age of the universe is estimated to be between 10 and 20 billion years old, while Earth coalesced from gathering interstellar matter about 4.6 bya.
2. The first atmosphere was likely to have been dominated by hot hydrogen gas. However, the Earth’s gravity was not strong enough to hold onto the light H2.
3. Studies of modern volcanoes suggest that Earth’s second early atmosphere was composed of water vapor, carbon dioxide, nitrogen, hydrogen sulfide (H2S), and possibly some methane (CH4) and ammonia (NH3).
4. Earth’s crust cooled and solidified, condensing water vapor into early seas. Early Earth was also subject to intense lightning, volcanic activity, and ultraviolet radiation (Figure 16.1A).

NOTE: It is ironic that life arose under conditions that included bombardment by UV radiation, and now a major environmental concern is the depletion of the ozone layer that protects the planet from this radiation (Modules 7.14 and 38.4).

1. Fossil evidence shows that photosynthetic prokaryotes existed by 3.5 bya (Figures 16.1B and C).

NOTE: The immensity of geological time and the very early events discussed can be made more meaningful by putting them in perspective. Borrowing an idea used by many, use a geologic time scale divided into a “life-on-Earth year.” On such a scale, prokaryotic life evolves in mid-March, eukaryotes first appeared around September 1, dinosaurs flourished around Christmas, and the typical human life span of 70 years is represented by the last half-second on December 31.

F. Because cyanobacterial photosynthesis is complex and advanced, the first cells likely evolved earlier, perhaps as early as 3.9 bya.